

4. Notes on the Hydroids and Nudibranchs of Bermuda*.
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(Text-figures 7-10.)

The writer spent the month of January 1909 in Bermuda, studying at the Biological Station on Agar's Island. The courtesy of the use of the Station was extended to me by the director, Professor E. L. Mark, to whom I express my thanks. The specific problem of research was an inquiry into the condition of the living nerve-cells of nudibranchs; but in addition some observations were made that may be worth recording.

Hardly a day passed that one or more *Aurelia* were not seen. Most of the specimens were small and none showed mature gonads. Vast quantities of sargassum were blown on to the various islands, and on all of this the common summer hydroids were found. Specimens of *Clytia simplex* and some unidentified campanularians were repeatedly examined, but on none of them were gonothecae present. *Aglaophenia minuta* was taken the latter part of January with many empty gonosomes; but other than this the hydroids on the sargassum did not show any signs of sexual activity.

Lytocarpus philippinus was in a very active healthy condition during the month and showed plenty of vitality by forming numerous asexual branches, but no gonosomes were noted. Congdon (07) speaks of slight variations from Nutting's description, in that "the colony [is] shorter." All of the colonies collected by us were at least eight inches high and some of them nearly a foot. They were taken in shallow water off Fairy-land Point.

Eudendrium hargitti was taken at Hungry Bay the last week in January. Two large colonies, about three inches high, were found; one of them was in fruit, the orange-coloured gonophores being very conspicuous.

One new hydroid, which has been handed to Professor Hargitt for description, was found growing on *Zoobotryon pellucidus*.

The writer regretted very much that the weather was unfavourable for collecting in Castle Harbor, where further opportunity would have been afforded to study the winter conditions of *Pennaria* and other hydroids.

CHROMODORIS ZEBRA Heilprin. (Text-fig. 7.)

This is one of the largest nudibranchs of Bermuda. It was first described, briefly, by Heilprin (89, p. 187, pl. 15, figs. 3, 3a), as follows:—"Animal of the form typical of the genus; head portion considerably extended and expanded in motion; caudal

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portion moderately elongated; base flattened; mantle beaded immediately over the tail.

"Color bright blue above, variously lined and streaked with light yellow; on the dorsal surface the yellow markings are disposed in longitudinal wavy or nearly straight lines, one or more specially prominent lines along the dorso-lateral border. Sides of animal irregularly reticulated or angulated with yellow markings; under surface pale blue, bordered with faint yellow. Rhinophores deep indigo or black, the rhinophoral aperture bordered with yellow; gills 12 or 13, black, bordered with yellow, and carrying blue cilia; under surface of head blue, with yellow spots.

"Length, when expanded, three and a half inches. Three specimens, dredged in about ten fathoms on the north side of Harrington Sound."

The few observations by Heilprin on the internal anatomy do not serve to distinguish this species from the other *Chromodoridæ* and so are omitted. He gives two rather generalized figures with but little accurate detail.

Other than the above, no description of this species has been made, so far as I have been able to determine. Bergh (92) questions whether *C. zebra* is a distinct species from *C. villafranca*, but this can not be settled until the anatomy has been thoroughly worked out; this will be done in a separate paper. The following observations on the external morphology add a number of facts to Heilprin's description.

Over fifty specimens were available for observation during the month, which gave ample opportunity to note a number of variations. The length of the body from the anterior tip of the mantle to the posterior end of the foot is 16 cm. This is the average length of the animals as they were crawling around in the aquaria. The body is much elongated and linear; it is thickest just anterior to the branchial plumes, becoming slightly depressed anteriorly. The mantle is rounded at each end and a little wider than the foot; it is slightly broader in its anterior than in its posterior portion, and projects beyond the end of the tentacles. The foot is uniformly narrow and linear; it tapers off to a point posteriorly, but its anterior end is squarish with rounded corners.

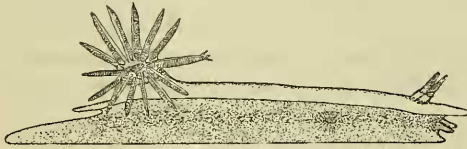
The ground-colour of the animal is blue. The foot is pale blue, but the intensity of the colour varies with different individuals. The margin and posterior tip are almost free from this ground-colour. The bottom of the foot is not modified by any other colour. The protrusible pharynx is likewise deeply coloured with a similar unmodified blue. This ground-colour of blue is not as conspicuous on the rest of the body, where there is a series of irregular streaks and a mottled effect produced by colours which range from a dark olive to orange. These markings are by no means the same in all individuals. In fact, of two dozen animals collected from the same spot at the same time, no two specimens were found to be alike. The dorsal margin of the foot is free

from the olive to orange colours, and the under edge of the mantle is generally so. The number of streaks and mottles is not constant. About 5 mm. back from the rhinophores and a little nearer the median plane, there are two oval spots of light blue, which are constant in position but not in shape nor in relation to the streaks.

The tentacles are short, retractile, conical, and blue in colour.

The rhinophores are perfoliate with 28 leaves in the clavus. The clavus is of a deep ultramarine blue, the deepest colour seen anywhere on the animal. The rhinophores may be retracted within conspicuous collars, which have smooth margins.

Text-fig. 7.



Chromodoris zebra Heilprin.

Viewed from the right side; the branchial rosette turned toward the observer.
 $\frac{1}{3}$ natural size.

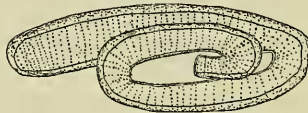
The branchiæ are from 12 to 14 in number; they are surrounded by a high sheath with a smooth margin, within which they are completely retractile. In the olive-coloured forms the branchiæ are often more deeply coloured than the mantle, and in such forms the backs of the plumes are slightly bronzed. The more orange-coloured individuals have light coloured branchiæ, which are frequently lighter in colour than the mantle. The branchiæ when fully expanded are rosette-like in outline and extend beyond the body. When in this expanded state, one readily notices an inner flesh-coloured collar that expands beyond the limits of the mantle-collar. The anal opening is subcentral, the ring formed by the bases of the branchiæ being open on the posterior and ventral margin. The tip of one or two of the branchiæ is seen to end in a minute division into two, three, or four parts. This is a very common characteristic, so that one hunts for some time before finding an animal which does not show it; only two such specimens were noticed. The gills occupy both sides of the plume as a series of about fifty leaves.

On the ventral, posterior border of the mantle there are five or six white conical elevations, which produce the beaded effect mentioned by Heilprin. The whitish colour is due to the presence of numerous globular structures, which turn pinkish in strong nitric acid. They were not destroyed, nor was there any effervescence, in nitric or hydrochloric acids. These white conical papillæ are noticeable in the living animal, but become more conspicuous after the animal has died.

The mouth is circular.

The genital opening is lateral and about one-third of the distance from the rhinophores to the branchiæ. It is noticeable as a slight prominence, which is blue in colour. The oviduct is protruded during oviposition and has the pale blue ground-colour. The deposition of the eggs does not seem to occur at any set time during the year. Mr. Mowbray has found eggs during every month of the year, and I secured a large quantity of them during January, 1909. The eggs are laid at any time during the day and often during the night. The external orifice of the oviduct is widely distended, a centimetre or more, and one can see the eggs within this opening for some distance, about 5 mm. The egg-mass (text-fig. 8) is in the form of a long, thick ribbon, often 150 mm. long and 15 mm. wide. When free from the animal, this ribbon tends to coil up, and it firmly adheres to the side of the aquarium by one of its edges. Two animals were timed during a part of the act of deposition, and from this as a basis I should estimate that the complete process would take three hours.

Text-fig. 8.

Egg-mass of *Chromodoris zebra* Heilprin.Seen obliquely. $\frac{1}{3}$ natural size.

An hour after the animal ceased laying, some of the eggs, but not all of them, showed two polar bodies. The eggs are laid in the jelly as a continuous string, which takes the form of a somewhat flattened spiral, so that when the broad face of the ribbon is viewed the string usually looks as though regularly folded back and forth across the ribbon. There are about one hundred eggs in a complete turn of the spiral, although this number is not constant. As there are from eighty to one hundred complete turns of the spiral, this would give from eight to ten thousand eggs to a single laying. It would be interesting to know how often each year they are capable of depositing such large numbers of eggs, but it is doubtful if this can be determined, as they are not hardy, soon dying even when placed in running water. It is probable that they come from the deeper water only to spawn, spending the rest of their time at some distance from shore. The egg are of a reddish-brown colour and develop slowly, as is shown by the fact that four and one-half hours after deposition they are still in the one-cell stage.

In the first lot of *Chromodoris zebra* collected there were over thirty specimens. The variation in colour was marked; one specimen of especial interest escaped my attention for a couple of days. This individual on close inspection proved to be a kind of albino. In size, shape, and general habits, it was undoubtedly

the same as the other individuals collected at this time, but the bluish ground-colour was entirely wanting. The following colour differences were conspicuous. The foot was white with no blotches or spots of any colour. The protrusible proboscis was entirely white. The rhinophores were of a light brown tipped with white. The collar of the branchial plumes showed an absence of colour, as did the back of each plume, so far as any ground-colour was concerned, a few spots of orange only remaining. The gills were colourless. The remainder of the body was streaked and mottled with a bright orange, but between these orange spots there was an entire absence of the usual ground-colour. Even in a preserved state, this albino can readily be distinguished from specimens which have the usual ground-colour of blue.

FACELINA AGARI, sp. n. (Text-fig. 9.)

It is impossible to be certain to which of the Eolidæ this species belongs, because only a single specimen was found, and the differences between the several subdivisions are so slight that a critical study of the morphology of a new species is necessary before one can feel certain where to place it. This form resembles *Facelina bostoniensis* more than it does any other one of the Eolidæ that I have thus far examined; but *F. bostoniensis* is referred to by Bergh (92, pp. 36, 40) under the name *Corphella* as well as *Facelina*. This seems to indicate that there is a considerable difference of opinion in reference to *F. bostoniensis*, and the same is true of several other forms. As soon as I can obtain more animals of this species, I hope to work out its anatomy in a critical manner, but until then I shall regard it as one of the Facelinidæ. This specimen was found under stones on the shores of Agar's Island, on which the Bermuda Biological Laboratory is located; so it seems appropriate to give it the specific name *agari*.

The body is long and slender—30 mm. long and 2 mm. wide. The rhinophores are club-shaped with conical tips, slightly contractile, and covered, except at the tip and base, with numerous small blunt tubercles. The presence and the shape of these tubercles on the rhinophores are a distinguishing characteristic of this form, and make one hesitate to place it in the genus *Facelina*, where the rhinophores are usually slender and perfoliate; however, this latter character is not a constant one.

The head is rounded, narrow; the tentacles occupy the sides of the head, and are conical, small in diameter, and longer than the rhinophores. Their surface is irregularly roughened. The foot is rounded anteriorly and bears a pair of distinct, angular, auriculate processes, which at first are easily mistaken for a second pair of head-tentacles. They are the foot-tentacles. The foot gradually tapers behind to a sharp point, the least bit of which can be seen posterior to the waving branchiæ. The foot is colourless and wider than the body.

The branchiæ are numerous and arranged along each side of the

body in several (six) more or less distinct groups. On the left side, lateral to the rhinophore, there are in the first group nine *very small* branchiæ. These are followed without any noticeable interval by twenty-one branchiæ of larger and uniform size. These all arise from near the edge of the dorsum, but bend over so as to give the appearance of growing out of the middle as well. In the third group of the left side there are twenty-two branchiæ, part of which grow out of the middle of the back. Then follows a free space about equal to the area occupied by the third group; next comes the fourth group with fifteen branchiæ, several of which are small. A few of these likewise arise from the middle of the back. Between the fourth and fifth groups there are two small branchiæ close to the foot (not shown in the figure). In the fifth group, nine were counted. The rest of the dorsum and side of the body has fifteen; these extend quite to the tip of the tail and entirely cover the body in this region. On the right side of the body, taking the branchiæ in the same order as on the left, first, there are nine small ones followed immediately by twenty-five; in the next (third) group twenty-four, then (fourth) thirteen, (fifth) eleven, and in the final group twenty-four.

Text-fig. 9.

*Facelina agari*, sp. n.

Viewed from the left side. Magnified 2 diameters.

Between the fourth and fifth groups on the right side there was one small branchia. These enumerations show that the total numbers (90 and 107) on the two sides of the body are not the same, and that the corresponding groups may differ widely in number. The branchiæ have an oscillating movement, which is quite regular when the animal is undisturbed.

The colour of the body is light chocolate. There are a few splotches of this colour on the dorsal-anterior portion of the foot. The portion of the body free from the branchiæ looks to the unaided eye as if there were numerous minute white spots all over it. Under the microscope, on a black background, these spots are seen to consist of from one to many white spherules grouped in a variety of odd shapes. These white spots thus viewed are so prominent on the light chocolate background, that they appear to be minute roughened areas; they do not, however, project beyond the surface. The branchiæ, especially those nearest the dorsal line, have a slight bluish colour around the base. Each branchia has a ground-colour of light chocolate with many white splotches irregularly disposed. The white splotches are many times larger than those on the dorsum. The tentacles have similar white splotches, but they are more numerous. The rhinophores are

slightly darker than the rest of the body, having less of the white. Near the tip of most of the branchiæ there is an irregular band of white; distal to this there is a narrow band of the ground-colour surrounding a central spot of white, which gives the appearance of an opening at the end of each branchia.

Extending from near the origin of each tentacle to the anterior edge of the base of the rhinophore of its own side, is a series of small tubercles. A similar row of tubercles runs laterally from the posterior base of each rhinophore, while a short row appears between the two rhinophores.

The species is hardy, living for some time in confinement.

The anal opening is lateral and is about one-third of the distance from the anterior to the posterior end of the body.

POLYCERELLA ZOOBOTRYON, sp. n. (Text-fig. 10.)

The genus *Polycerella* was established by Verrill (80, p. 387; 82, p. 548) in 1880, when he described *P. emertoni*, taken at Wood's Holl in 1875 and later at New Haven and Newport. Since that time there have not been any additions to this genus.

The present species was first observed by Mr. L. Mowbray in December 1908, while he was trying to determine the reproductive stages of *Zoobotryon pellucidus*. At present it seems to live on this bryozoan and not on any of the other organisms growing near it. Several specimens were taken during my stay in Bermuda, and in every instance they were found on this bryozoan. The fact that *Zoobotryon pellucidus* has recently taken up quarters in Bermuda, would seem to indicate that this habitat was also recently assumed by this species of *Polycerella*, especially as this bryozoan was under observation during the past summer and no nudibranchs were seen upon it. It is also probable that this nudibranch did not come to Bermuda with *Zoobotryon*, because the genus is very abundant in several localities and has been thoroughly studied by Reichert (70), and yet no mention has ever been made of a nudibranch belonging to the *Polycerella* in connection with it.

Polycerella zoobotryon is a small nudibranch, from 5 to 6 mm. in length and $1\frac{1}{2}$ mm. wide. The body is thickest just anterior to the branchial plumes. The shape is much as in *Polycera*—elongated, narrow, and about as high as broad. Body compressed, smooth, sloping rather abruptly from the branchial plumes posteriorly until it merges into the long pointed tail, which is much narrower and thinner, and nearly one-third the total length of the animal. The head is blunt and squarish. The tentacles are cylindrical, non-retractile, and one-fourth the length of the rhinophores.

The rhinophores are non-retractile, cylindrical, each having from three to six cup-like, equidistant folds on the posterior surface of its distal two-thirds.

On the sides and dorsum of the body there are a number of short clavate papillæ, the tips of which are translucent. The

number is not constant, but ranges from 16 to 19. Their distribution is as follows:—Of eight which are constant in position, two occupy the median plane, one of them behind the rhinophores about one-sixth of the distance between base of branchial plumes and rhinophores, the other in front of the plumes about one-fourth of the same distance. The remaining six are arranged in pairs near the median plane, one pair a little in front of the rhinophores and distant from each other about the thickness of a papilla; a second pair slightly in front of the posterior median papilla and a little further apart than the anterior pair; the third pair nearly as much behind the plumes as the posterior median papilla is in front of them; these are still further from each other.

In addition to these eight papillæ, there are on the dorsum near its lateral margins from eight to eleven papillæ. There are four on each side, or four on one side and five on the other, or, finally, five on one side and six on the other.

Text-fig. 10.

*Polycerella zoobotryon*, sp. n.

Dorsal view. Magnified 8 diameters.

The ground-colour is whitish, mottled with light brown arranged in irregular splotches. A less abundant darker brown is disposed in streaks across the lighter brown. The foot is white and without any colour markings. Its margin, as well as the tips of the papillæ, is translucent.

The foot is smooth and slightly notched anteriorly. The mouth is T-shaped. The anal opening is subcentral in position, and the excretory orifice is just posterior to it, both being surrounded by the gills.

The gills consist of four or five more or less irregularly branching plumes.

When at rest the body is shortened, the tentacles drop back alongside the body, and the rhinophores lie on the dorsum. The papillæ, which are constantly in motion when the animal is crawling, are bent dorsally when it is at rest, and are often knobbed.

Under a low power lens one can see the long cilia in motion. The animal assumes a variety of positions while in this resting state, and it frequently rests on its back. The foot may be fully expanded or much contracted. When the animal was placed in a weak solution of methylene-blue in sea-water, the cup-like folds on the rhinophores appeared as swellings, and after a few hours the lateral papillæ and rhinophores were sloughed off.

The eggs are laid in a cylindrical mass of jelly. The number varies from one hundred to three hundred in each mass. Each animal lays several egg-masses.

The animals are very hardy, living in confinement for over six weeks.

A paper on the anatomy of this species is well under way and will be published separately.

BIBLIOGRAPHY.

CONGDON, E. D.

- (07.) The Hydroids of Bermuda. Proc. Amer. Acad. Arts and Sci. vol. xlii. no. 18, pp. 461-485. Contributions Bermuda Biol. Sta., No. 9.

BERGH, R.

- (92.) System der Nudibranchiaten Gasteropoden. In Karl Semper's Reisen im Archipel der Philippinen, Theil ii. Bd. ii. Heft 18, pp. 993-1165.
Also separately, Wiesbaden: Kreidel, 173 pp.

HEILPRIN, A.

- (89.) The Bermuda Islands. Philadelphia, [vi]+231 pp., 17 pls.

REICHERT, K. B.

- (70.) Vergleichende anatomische Untersuchungen über *Zoobotryon pellucidus* (Ehrenberg). Abhandl. phys. Kl. königl. Akad. Wissensch. Berlin, Jahrg. 1869, pp. 233-338, 6 Taf.

VERRILL, A. E.

- (80.) Notice of recent Additions to the Marine Invertebrata of the North-eastern Coast of America, with Descriptions of new Genera and Species and Critical Remarks on others. Part II. Proc. U.S. Nat. Mus., vol. iii. pp. 356-405, Dec. 1880.
- (82.) Catalogue of Marine Mollusca added to the Fauna of the New England Region during the past Ten Years. Trans. Conn. Acad. Sci., vol. v. pt. 2, pp. 447-587, pls. 42-44, 57, 58.